Reviewer 2:

This paper describes a regional model with downscaling capabilities, such that the model resolves a large domain including the mid-Atlantic bight and Gulf of Maine, while also resolving a tidal wetland in detail. This 'seamless' approach is an important advancement in regional modeling, and mirrors recent work by the ICON team ('Seamless Integration of the Coastal Ocean in Global Marine Carbon Cycle Modeling' by Mathis et al., JAMES, 2022). I would recommend the authors acknowledge this related work. While I am very impressed with this effort, I think that there are some issues that need to be addressed and acknowledged (if not fixed) before this work can be published. My concerns are centered around model fidelity at the smallest and largest scales, and the connections between these scales, which I don't think has been adequately demonstrated.

Thanks for referring to the ICON work, we have acknowledged this work in introduction at lines #44-49.

Our response for the concerns centered around model fidelity is in the corresponding comments below. Overall, this study builds upon a substantial body of work demonstrating SCHISM's seamless capabilities across multiple spatial and temporal scales. Therefore, we streamlined some validation details in the manuscript to maintain clarity and conciseness.

First, at the smallest scales, I am worried that the large timestep reduces the model accuracy. The authors state "Notably, the model's scheme bypasses the constraints of the Courant-Friedrichs-Lewy condition (Zhang et al., 2016), allowing for the use of relatively large time steps even with high-resolution grids that capture detailed geomorphic features." Model stability is not the same as model accuracy, and running at timesteps greater than CFL prescribes can lead to model degradation, even if the model remains stable. The authors need to discuss the accuracy of their numerical schemes at the smallest scales, as these are what typically set the timestep.

Thank you for raising this important point regarding the distinction between numerical stability and model accuracy. SCHISM employs semi-implicit time-stepping schemes that allow the model to bypass the stringent Courant–Friedrichs–Lewy (CFL) constraints typically associated with explicit schemes (Zhang and Baptista, 2008; Zhang et al., 2016). In fact, SCHISM performs optimally at CFL numbers greater than 0.4—a reversal of traditional CFL constraints where CFL < 1 is required for stability (https://schism-dev.github.io/schism/master/getting-started/grid-generation.html). Specifically, SCHISM utilizes an Eulerian–Lagrangian Method (ELM) for momentum advection, which further alleviates numerical stability limitations. Larger time steps introduce temporal truncation errors, but they also reduce numerical diffusion in the ELM framework. On the other hand, excessively small time steps may degrade model skill due to overly low CFL values. Therefore, selecting the time step involves a careful balance between accuracy, computational efficiency, and robustness, particularly in baroclinic environments spanning shallow to deep waters.

For a fixed mesh, model accuracy has been shown to be well maintained for 3D simulations with timesteps ranging from 100 to 200 seconds (Zhang et al., 2016). The model skill at reproducing small-scale hydrodynamic processes has been demonstrated in prior applications, including wake formation near bridge pilings (Liu et al., 2018), hydraulic jumps (Zhang et al., 2020), and marsh-vegetation interactions (Zhang et al., 2019; Cai et al., 2023)—all of which employed similarly large timesteps from 100 to 200 seconds. These successes highlight SCHISM's effective balance between numerical dissipation (due to semi-implicit scheme) and numerical dispersion (Finite-Element Method). The Crank–Nicolson method, known for preserving wave propagation fidelity, further supports this balance.

The selected time step of 150 seconds for the NAAC (v1.0) configuration falls within validated range established through previous applications of SCHISM across U.S. East Coast estuaries and global domains (Ye et al., 2018; Ye et al., 2020; Cai et al., 2022; Cai et al., 2023; Zhang et al., 2023). This value has shown to be both stable and accurate at the grid resolution used in NAAC (v1.0).

We revised the manuscript accordingly to reflect this discussion at lines #153-161.

At the largest scales, it is not clear to me that the model reproduces large scale shelf features well. A single snapshot of the Gulf Stream surface currents is not sufficient evidence that the key features on the shelf are reproduced. This is important because it is the whole point of the 'seamless' downscaling approach -- that the larger scale (shelf) processes that influence the smaller scale (bay/wetland) processes are all reasonably reproduced.

At the largest scales, the model's capability in capturing shelf processes has been demonstrated through several closely related studies, including Cui et al. (2024) for shelf current dynamics, Huang et al. (2024) for shelf responses to hurricane events, and Park et al. (2024) for coastally trapped wave propagation along the U.S. Atlantic shelf. Specifically for this study, we now introduce a passive tracer experiment as shown in the next reply.

Finally, given this last point, it would be good to see some evidence that there is indeed a connection between the shelf and the wetlands. I would prefer to see some relationship in terms of tracers (temperature or salinity) rather than tidal flows that at least qualitatively demonstrates how shelf processes might influence the wetland region.

We agree that illustrating tracer transport helps clarify the linkage between large-scale and small-scale processes. Given that multiple SCHISM modeling papers have already shown shelf processes using temperature and salinity (e.g., Ye et al., 2020) and for the purpose of directly illustrate wetland-to-shelf transport pathways, here we employ a passive conservative tracer initialized in the marsh region as an additional diagnostic. This approach isolates physical transport mechanisms without interference from internal sources or sinks, providing clear evidence of shelf influence on the material transport sourced from a tidal wetland. We added Fig. 15: a log-scale plot showing the distribution of a passive tracer continuously released from a constant source at the wetlands in Plum Island Estuary. This tracer visualization illustrates the general transport pathways and highlights how oceanic processes (e.g., Gulf Stream, Shelf-break Jet and Georges Bank Gyre) influence the movement and exchange of materials from small wetlands and water bodies to adjacent regions. The text on this discussion can be found at lines #388-413.

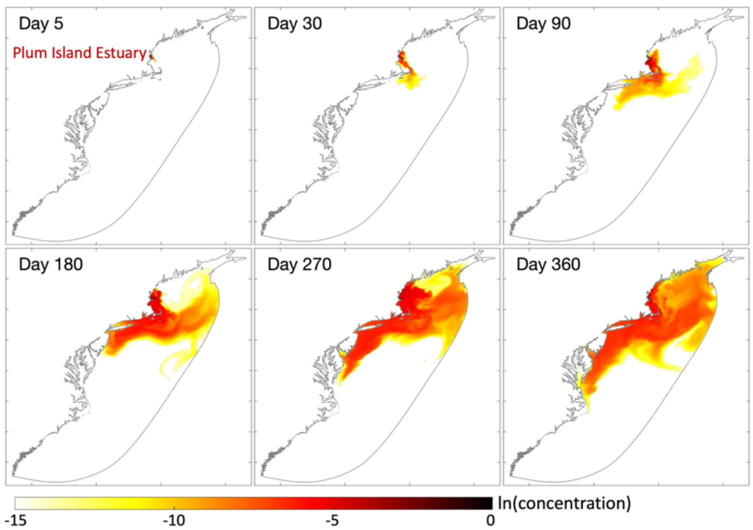

Figure 15: Log-scale plot showing the distribution of a passive tracer released continuously from a constant source of wetlands at Plum Island Estuary.

In summary, I'm very impressed by the model application development, but I am not yet convinced of its usefulness.

We appreciate your thoughtful feedback and hope the clarifications above help to address your concerns.

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